Mortality Risk Following Nonfatal Injuries With Alcohol Use Disorder Involvement: A One-Year Follow-Up of Emergency Department Patients Using Linked Administrative Data

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ABSTRACT. Objective: Patient presentations to the emergency department (ED) for alcohol-involved injury represent a growing public health burden, but their characteristics and sequelae remain understudied. This study examined mortality rates among ED patients presenting with alcohol-involved injuries and assessed how mortality varied by injury intent and other characteristics. **Method:** This retrospective cohort study used statewide, longitudinally linked ED patient record and mortality data from California. Participants comprised all residents presenting to a licensed ED in 2009–2012 with a nonfatal injury that involved comorbid diagnosis of alcohol use disorder (AUD; n = 261,222; 59.3% male). Injury intent was defined using *International Classification of Diseases, 9th Revision, Clinical Modification* external cause-of-injury codes. Cox regression was used to investigate factors associated with 12-month all-cause mortality rates. Age-, sex-, and race/ethnicity-adjusted standardized mortality ratios (SMRs) were calculated using statewide mortality data. **Results:** Most ED injury visits involving an AUD diagnosis were coded as unintentional (75.9%). Following the index ED visit, all-cause mortality among AUD-involved injury patients was 5,205 per 100,000 person-years, five times higher than the demographically matched population (SMR = 5.3; 95% confidence interval [5.2, 5.4]). Adjusted Cox regression models indicated that patients whose index injury was unintentional, and whose AUD was for acute intoxication, had significantly higher mortality. Most deaths among unintentionally injured patients were from natural causes, whereas external-cause deaths were relatively more common in the other patient groups. **Conclusions:** AUD-involved injury presentations to the ED in California are common and associated with high patient mortality burden, which varies by injury intent. Interventions are needed to reduce excess mortality in these patients. (*J. Stud. Alcohol Drugs, 83,* 879–887, 2022)

ALCOHOL IS THE MOST COMMONLY USED intoxicant in the United States and is responsible for significant public health burden in terms of both morbidity and mortality (Substance Abuse and Mental Health Services Administration, 2019). Research suggests that alcohol consumption, problematic alcohol use, and alcohol-related deaths have increased substantially in the United States over the past 20 years, especially for women (Shmulewitz et al., 2021; Spillane et al., 2020; White et al., 2018, 2020). Problematic alcohol use can lead to serious health consequences, including liver disease and cancer in the long term and significantly elevated risk of injury in the short term, including injuries serious enough to require emergency care (Cherpitel et al., 2009; Chikritzhs & Livingston, 2021). Rates of alcohol-involved injury emergency department (ED) visits, and the costs associated with such visits, appear to be rising along with other public health indicators of problematic alcohol use (DiMaggio et al., 2021).

EDs may represent a key context for helping close enduring treatment gaps among people with problematic alcohol use through screening, initiating treatment, and linking them to outpatient care (Hawk & D'Onofrio, 2018). Brief ED-based interventions have been shown to reduce future alcohol consumption and related consequences, including alcohol-related injuries, while remaining cost-effective (Barata et al., 2017; D'Onofrio & Degutis, 2002; D'Onofrio et al., 2012; Gentilello et al., 2005; Landy et al., 2016; Schmidt et al., 2016; White et al., 2018). However, although an estimated 30% of injured ED patients screen positive (via breath or blood tests) for alcohol involvement (Gentilello et al., 2005) and up to 40% of individuals with moderate to severe alcohol use disorders (AUDs) report making an ED visit in the past year (Mintz et al., 2021), only 15% of ED trauma centers have formal alcohol screening and intervention policies, despite widespread support for implementing such policies (Cunningham et al., 2010).

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To appropriately target ED-based interventions for the prevention of morbidity and mortality, more information is needed about injury patients with AUD involvement, their injuries, and their subsequent mortality experiences (DiMaggio et al., 2021). Previous work has shown that alcohol involvement increases the risk of in-ED mortality among injured patients, but this likely represents a substantial underestimate of their near-term mortality risk (Cornwell et al., 1998). Other studies, all from international settings, have found excess all-cause mortality among ED patients presenting with AUDs, but these studies did not focus specifically on alcohol involvement among injury patients (Gunnarsdottir et al., 2014; Hulme et al., 2020; Kendler et al., 2016). No U.S.-based study that we are aware of has examined all-cause or cause-specific mortality rates among AUD-involved injury patients in ED settings.

Another major gap in the field is the lack of empirical data on the distribution of injury intent among AUD-involved injury ED patients, and how injury intent is related to these patients' mortality risk. Many injuries coded as intentional self-harm or assault involve alcohol (Goldman-Mellor et al., 2019; Kool et al., 2018), but no study we are aware of has examined what proportion of AUD-involved injuries are of accidental versus deliberate self-harm, assault, or undetermined intent. Moreover, no study has examined variability in patients' mortality experiences according to their injury intent. This knowledge gap is important because research has shown that the documented intent of substance-related ED visits can be strongly associated with subsequent mortality risks in those patients (Olfson et al., 2020).

The current study used ED patient data from California, a large state with rigorous injury intent coding practices, to determine the relative frequency of coded intent (unintentional, assault, deliberate self-harm, or undetermined) among AUD-involved injury visits. We also used linked mortality data to estimate subsequent mortality rates among patients with such injuries and examined how those death rates varied by injury intent and other patient characteristics.

Method

Data

We obtained discharge data from the California Office of Statewide Health Planning and Development (OSHPD) on all visits between 2009 and 2012 to all California-licensed EDs by individuals ages 10 years and older with a California residential zip code. OSHPD also provided information on all individuals in this ED cohort to the California Department of Public Health Vital Records, which assessed vital status in California death records and provided information on the date and underlying cause of death for all matching decedents who died in 2009–2013 (excluding those who died out of state, <1% of the total), the most recent years of mortality data available at the time of this analysis. Probabilistic linkage matching was implemented based on the patient's Social Security number, gender, birth date, race/ethnicity, and zip code of residence. All data obtained and used by the study team were de-identified. The Institutional Review Boards of the California Health and Human Services Agency and the University of California, Merced, approved this study.

For the current study, we first retained all patient visits coded as involving an external-cause injury (defined as those with an *International Classification of Diseases, 9th Revision, Clinical Modification* [ICD-9-CM; National Center for Health Statistics, 2011] E-code in any diagnostic position). California has mandated 100% reporting of external cause-of-injury codes since 1990. We then assessed comorbid AUD involvement at each visit, defined as the presence of an ICD-9-CM code in any diagnostic position corresponding to alcoholic psychosis (291), alcohol abuse (305.0, 303.0), alcohol dependence syndrome (303.9), alcohol poisoning (980.0, 980.1, 980.9, E860.0, E860.1, E860.2, E860.9), or excessive blood levels of alcohol (790.3) (Centers for Disease Control and Prevention [CDC], 2021). We use the term *AUD-involved injury* throughout with the recognition that we did not have access to patient blood alcohol content information, and that not all AUD-diagnosed patients were necessarily consuming alcohol at the time of their injury.

All subsequent analyses were restricted to qualifying index visits for AUD-involved injury among patients ages 10 years and older in 2009–2012, defined as the patient's first qualifying visit during the study period. For visits resulting in patient discharge or transfer to another facility, the index date was the date of ED presentation. For visits that resulted in a same-hospital admission, the index date was the date of discharge from the associated hospitalization (Olfson et al., 2017). Visits that lacked Social Security numbers, or patients whose index visit resulted in death, were excluded from follow-up analyses.

Measures

The primary outcome was death within 12 months of the index date by any cause, identified through linkage with the state Vital Records. This follow-up period was chosen to maximize the available data and because ED-based alcohol interventions have demonstrated effectiveness for up to 12 months (Barata et al., 2017; D'Onofrio et al., 2012; Tanner-Smith & Lipsey, 2015).

Patient demographic characteristics were examined for descriptive purposes and to calculate hazard ratios [HRs]. These characteristics included gender (male, female), age group (10–24, 25–44, 45–64, ≥65 years), race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, Asian/Pacific Islander, other), and insurance status (private, Med-

icaid, Medicare, self-pay/other). We also assessed the intent and disposition of the index injury. Injury intent, based on the E-code in the primary diagnostic position, was defined as unintentional (E000–E949), deliberate self-harm (E950–E959), assault (E960–E979), or undetermined (E980–E989). Disposition was coded as routine discharge home, admitted as an inpatient, or other; patients who died were excluded from follow-up analyses. Last, we classified the patient's index AUD diagnosis type according to their first-listed AUD diagnosis code (where there were multiple such codes), into categories of "alcohol abuse or dependence" or "acute alcohol poisoning" (which included alcohol poisoning, alcoholic psychosis, and excessive blood levels of alcohol).

Analyses

Crude mortality rates per 100,000 person-years of follow-up were calculated for all-cause mortality in the year after the index date. Individuals who did not link to California mortality records from 365 days after the index date were presumed alive for this period. Decedents were treated as censored on their death date. For calculation of standardized mortality ratios (SMRs), data on death by manner for California overall in 2009–2013 were obtained from the CDC's WONDER system (CDC, 2017).

Mortality rates according to patient age, gender, race/ethnicity, insurance status, index AUD diagnosis type, and index injury intent were compared using Cox proportional hazards regression. All variables were entered into one adjusted model to assess their unique contributions to all-cause mortality risk. We also examined the relative contribution of natural causes (ICD-10 cause-of-death codes A00–R99, Z00–Z99, U00–U49, or U82–U85) versus external causes (codes S00–Y98) to overall mortality.

Last, we assessed whether the association between injury intent and mortality risk varied by gender, first using gender-stratified SMRs and Cox proportional hazards models (controlling for other demographic factors) and then specifying a combined model with an interaction term between injury intent and gender. All statistical analyses were conducted using Stata 14.0 (StataCorp LP, College Station, TX).

Results

Californians age 10 years and older made 10,059,640 ED visits for injury between 2009 and 2012. Approximately 4% of these visits (n = 388,565 visits; 3.9%) had a comorbid diagnosis indicating alcohol involvement. Three quarters of these AUD-involved injuries were coded as unintentional (75.9%), with 14.1% attributable to assault, 7.7% attributable to self-harm, and 2.3% of undetermined intent. Male patients accounted for two thirds of all AUD-involved injury visits (62.5%), but this proportion varied considerably by injury intent (Table 1). Patient age, race/ethnicity, insurance status, and visit disposition distributions also varied substantially by injury intent.

There were 263,657 unique patients with a qualifying index AUD-involved injury in 2009–2012. Of those, 2,435 (0.9%) died on the day of their index visit and were excluded from follow-up analyses, leaving 261,222 patients with qualifying nonfatal index injuries. The proportions with an index injury of unintentional, assault, self-harm, or undetermined intent were very similar to those in the all-visits sample (76.9%, 13.2%, 7.9%, and 2.1%, respectively). Of these 261,222 AUD-involved injury patients, a total of 13,175 died within 12 months of their index visit, resulting in an all-cause mortality rate of 5,204.6 per 100,000 (Table 2). This rate was five times higher than that of the demographically matched California population (SMR = 5.3, 95% confidence interval [CI] [5.2, 5.4]). Most of the deaths in our cohort were from natural causes (n = 11,021; 83.7%), predominantly from circulatory system disease (n = 3,653; 33.2% of all natural-cause deaths), cancer (n = 2,213; 20.1%), or digestive system diseases (n = 1,550; 14.1%). Of the remaining 2,154 deaths that were from external causes, the majority comprised unintentional injuries (n = 1,498; 69.6%), with suicide accounting for 20.1% (n = 433) and homicide 5.5% (n = 119).

In a Cox proportional hazards model that included all predictor variables, the all-cause mortality rate among AUD-involved injury patients increased with patient age, male gender, and White race/ethnicity. Compared with patients who had private insurance at index visit, those with Medicaid had 71% (HR_{adj} = 1.71, 95% CI [1.61, 1.81]) and those with Medicare had 58% (HR_{adj} = 1.58, 95% CI [1.47, 1.62]) greater risks of dying during follow-up.

Mortality risk was also associated with index injury intent (Table 2 and Figure 1). Patients whose index AUD–involved injury was unintentional had the highest crude mortality rate, at 6,212 per 100,000; this corresponded to an SMR of 5.28 (95% CI [5.19, 5.38]). Compared with unintentionally injured patients and adjusting for patient age, gender, race/ethnicity, and insurance status, patients whose index injuries were coded as deliberate self-harm or assault were less likely to die during follow-up (HR_{adj} = 0.81, 95% CI [0.74, 0.89]; and HR_{adj} = 0.58, 95% CI [0.53, 0.64], respectively). Self-harm patients had an SMR of 6.31 (95% CI [5.75, 6.92]), whereas assault-injured patients had an SMR of 4.43 (95% CI [4.04, 4.85]). Patients whose index AUD–involved injuries were coded as "undetermined intent" were more likely than unintentionally injured patients to die after accounting for confounders (HR_{adj} = 1.33, 95% CI [1.17, 1.52]); they also had the highest SMR (9.24; 95% CI [8.11, 10.49]).

The relative contribution of natural causes versus external causes to overall mortality varied by index injury intent (Figure 1). Natural-cause deaths accounted for the vast majority (87.0%; n = 10,454) of deaths among patients whose index injuries were unintentional. Many of these deaths were

TABLE 1. Characteristics of AUD-involved injury visits treated in California emergency departments (2009–2012)

	All AUD-involved injury visits		Unintentional injury visits		Deliberate self-harm injury visits		Assault injury visits		Undetermined intent injury visits	
Characteristic	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
All	388,565	100%	294,848	100%	29,910	100%	54,806	100%	9,001	100%
Sex										
Male	242,883	62.5%	179,692	60.9%	13,302	44.5%	44,450	81.1%	5,439	60.4%
Female	145,682	37.5%	115,156	39.1%	16,608	55.5%	10,356	18.9%	3,562	39.6%
Age group, in years										
10–24	65,735	16.9%	41,953	14.2%	6,437	21.5%	15,276	27.9%	2,069	23.0%
25–44	125,611	32.3%	84,244	28.6%	13,171	44.0%	24,746	45.2%	3,450	38.3%
45–64	144,162	37.1%	117,381	39.8%	9,607	32.1%	14,065	25.7%	3,109	34.5%
≥65	53,057	13.7%	51,270	17.4%	695	2.3%	719	1.3%	373	4.1%
Race/ethnicity										
Non-Hispanic White	218,646	56.3%	172,115	58.4%	19,245	64.3%	22,238	40.6%	5,048	56.1%
Non-Hispanic Black	35,866	9.2%	26,145	8.9%	1,884	6.3%	6,935	12.7%	902	10.0%
Hispanic	104,714	27.0%	74,592	25.3%	6,661	22.3%	21,054	38.4%	2,407	26.7%
Non-Hispanic Asian/ Pacific Islander	10,116	2.6%	8,187	2.8%	688	2.3%	1,069	2.0%	172	1.9%
Non-Hispanic other race	19,223	5.0%	13,809	4.7%	1,432	4.8%	3,510	6.4%	472	5.2%
Payer										
Private	107,302	27.7%	84,381	28.7%	10,311	34.5%	10,110	18.5%	2,500	27.8%
Medicaid	91,502	23.6%	65,926	22.4%	7,777	26.0%	15,395	28.1%	2,404	26.7%
Medicare	66,605	17.2%	59,898	20.3%	2,894	9.7%	2,748	5.0%	1,065	11.8%
Self-pay	107,933	27.8%	73,806	25.1%	7,935	26.5%	23,469	42.8%	2,723	30.3%
Other/unknown	14,782	3.8%	10,423	3.5%	981	3.3%	3,073	5.6%	305	3.4%
Intent of injury										
Unintentional	294,848	75.9%	–	–	–	–	–	–	–	–
Self-harm	29,910	7.7%	–	–	–	–	–	–	–	–
Assault	54,806	14.1%	–	–	–	–	–	–	–	–
Undetermined	9,001	2.3%	–	–	–	–	–	–	–	–
Disposition										
Discharged home	232,728	59.9%	179,304	60.8%	8,468	28.3%	39,768	72.6%	5,188	57.6%
Admitted	144,172	37.1%	107,332	36.4%	20,693	69.2%	12,579	23.0%	3,568	39.6%
Other	8,440	2.2%	5,345	1.8%	608	2.0%	2,362	4.3%	125	1.4%
Died	3,225	0.8%	2,867	1.0%	141	0.5%	97	0.2%	120	1.3%

Note: AUD = alcohol use disorder.

attributable to ischemic heart disease (16%), liver disease (11%), and respiratory diseases like chronic obstructive pulmonary disease (11%). By contrast, in the assault-injured AUD group, only 54% (n = 253) of deaths were from natural causes, and just 39% (n = 177) in the self-harm intent group. For the undetermined-intent injury group, 57% of deaths (n = 137) were attributable to natural causes and 43% (n = 102) to external causes.

Mortality risk also varied by the AUD recorded at the index injury. Compared with patients whose index AUD diagnosis was for alcohol abuse or dependence, those whose AUD diagnosis was for acute alcohol intoxication had a 33% higher mortality rate (HR_{adj} = 1.33, 95% CI [1.28, 1.38]), even accounting for patient sociodemographic characteristics and injury intent. These groups' SMRs also differed slightly: mortality among patients with an AUD for alcohol abuse/dependence was approximately 5 times higher than that among the demographically matched California population (SMR = 4.98; 95% CI [4.86, 5.10]), whereas mortality among patients with alcohol intoxication was 5.7 times higher than the demographically matched population (SMR = 5.69; 95% CI [5.55, 5.83]).

The relationship between injury intent and all-cause mortality differed slightly for male versus female patients (Table 3). A self-harm index injury was associated with reduced mortality risk for both sexes (female HR_{adj} = 0.72, 95% CI [0.62, 0.83]; male HR = 0.88, 95% CI [0.78, 1.03]; p for interaction = .051). Although the mortality risk reduction associated with an assault injury was evident for both genders, the magnitude of this reduction was greater for males (male HR_{adj} = 0.53, 95% CI [0.47, 0.59]; female HR = 0.71, 95% CI [0.61, 0.82]; p for interaction < .001). Gender differences in the association between undetermined-intent injury and mortality risk were not statistically significant (p for interaction = .59). Mortality rates among female injury patients with AUD involvement were 4.8 times higher than the age- and race/ethnicity-matched California population (SMR = 4.84, 95% CI [4.71, 4.97]), whereas mortality rates among male patients were 5.7 times higher than the demographically matched population (SMR = 5.70, 95% CI [5.57, 5.82]).

TABLE 2. 12-month mortality rates among 261,222 emergency department patients with an index nonfatal AUD-involved injury in California, 2009–2012

	12-month all-cause mortality rate per 100,000 person-years			Adjusted Cox proportional hazards model for 12-month all-cause mortality	
Characteristic	No. of deaths	Rate	[95% CI]	HR_{adj}[b]	[95% CI]
All	13,175	5,204.6	[5116.5, 5294.2]	–	–
Age group, in years[a]					
10–24	193	460.8	[400.2, 530.6]	1.05	[1.051, 1.053]
25–44	1,230	1,478.4	[1398.1, 1563.4]		
45–64	5,185	5,694.6	[5541.7, 5851.7]		
≥65	6,567	17,742.7	[17318.7, 18177.1]		
Sex					
Male	7,881	5,247.9	[5133.3, 5365.0]	1.61	[1.55, 1.67]
Female	5,294	5,141.4	[5004.8, 5281.8]	1.0	(ref.)
Race/ethnicity					
Non-Hispanic White	9,312	6,345.8	[6218.2, 6476.0]	1.0	(ref.)
Non-Hispanic Black	1,050	4,044.5	[3807.1, 4296.7]	0.87	[0.81, 0.92]
Hispanic	2,025	3,342.5	[3200.1, 3491.3]	0.82	[0.78, 0.86]
Non-Hispanic Asian	396	5,405.0	[4898.0, 5964.5]	0.82	[0.74, 0.90]
Non-Hispanic other	392	3,128.6	[2833.8, 3454.2]	0.77	[0.69, 0.85]
Payer					
Private	2,695	3,433.6	[3306.4, 3565.7]	1.0	(ref.)
Medicaid	2,317	4,071.7	[3909.2, 4240.9]	1.71	[1.61, 1.81]
Medicare	6,678	15,220.3	[14859.6, 15589.8]	1.55	[1.47, 1.62]
Self-pay	1,236	1,930.7	[1826.0, 2041.3]	0.96	[0.89, 1.03]
Other/unknown	240	2,526.7	[2226.4, 2867.4]	1.01	[0.88, 1.15]
Intent of injury					
Unintentional	12,012	6,211.6	[6101.5, 6323.7]	1.0	(ref.)
Self-harm	454	2,240.8	[2043.9, 2456.7]	0.81	[0.74, 0.89]
Assault	470	1,374.9	[1256.1, 1505.0]	0.58	[0.53, 0.64]
Undetermined	239	4,494.7	[3959.5, 5102.3]	1.33	[1.17, 1.52]
AUD diagnosis type					
Alcohol abuse or dependence	6,789	3,809.0	[3719.4, 3900.7]	1.0	
Acute alcohol intoxication	6,292	8,424.6	[8219.0, 8635.4]	1.33	[1.28, 1.38]

Notes: AUD = alcohol use disorder; no. = number; CI = confidence interval; HR_{adj} = adjusted hazard ratio; ref. = reference. [a]Age was entered as a continuous variable in the Cox proportional hazards model; [b]adjusted HR model controls for all variables shown in the table.

Discussion

This study is the first population-based analysis from the United States to assess mortality rates and injury intent among patients presenting to the ED with an AUD-involved injury. Our findings indicate that only a small proportion of injury ED patient visits involve a documented diagnosis of AUD, but that in this patient group, 1 in 20 patients die within 12 months of their index ED visit. All-cause mortality risk was particularly elevated for AUD-involved injury patients who were older and for those of non-Hispanic White race/ethnicity, as well as those covered by Medicaid or Medicare. Our findings also contribute to the literature by showing that most AUD-involved injury visits stem from unintentional injuries, but substantial proportions resulted from assault (14%) or deliberate self-harm (7.7%), and that mortality risk among AUD-involved injury patients differs by the intent of the index injury. Unintentionally injured patients were at highest risk. These findings highlight the potential value of more aggressive models of postdischarge follow-up services, such as case management and assertive outreach, in this specific patient population (Parkman et al., 2017b; Passetti et al., 2016).

Previous estimates of the proportion of ED visits involving alcohol have ranged from 3% to 38% (Bernstein et al., 2007; Gentilello et al., 2005), depending on the sample and assessment method for alcohol involvement, which often comprised breath- or blood-alcohol content assays. Our analysis focused specifically on ED visits for injury, limiting comparability with prior work. Moreover, we relied on ICD-9-CM AUD diagnoses documented in administrative patient data, which may substantially undercount patients' alcohol misuse; our estimate is thus likely to be conservative (McKenzie et al., 2010; Rockett et al., 2003; Solomon et al., 1980). This underscores the importance of universal alcohol screening and intervention policies in ED settings (Cunningham et al., 2010).

The finding that relatively substantial proportions of AUD-involved injury ED visits are due to assault or intentional self-harm is consistent with research showing that

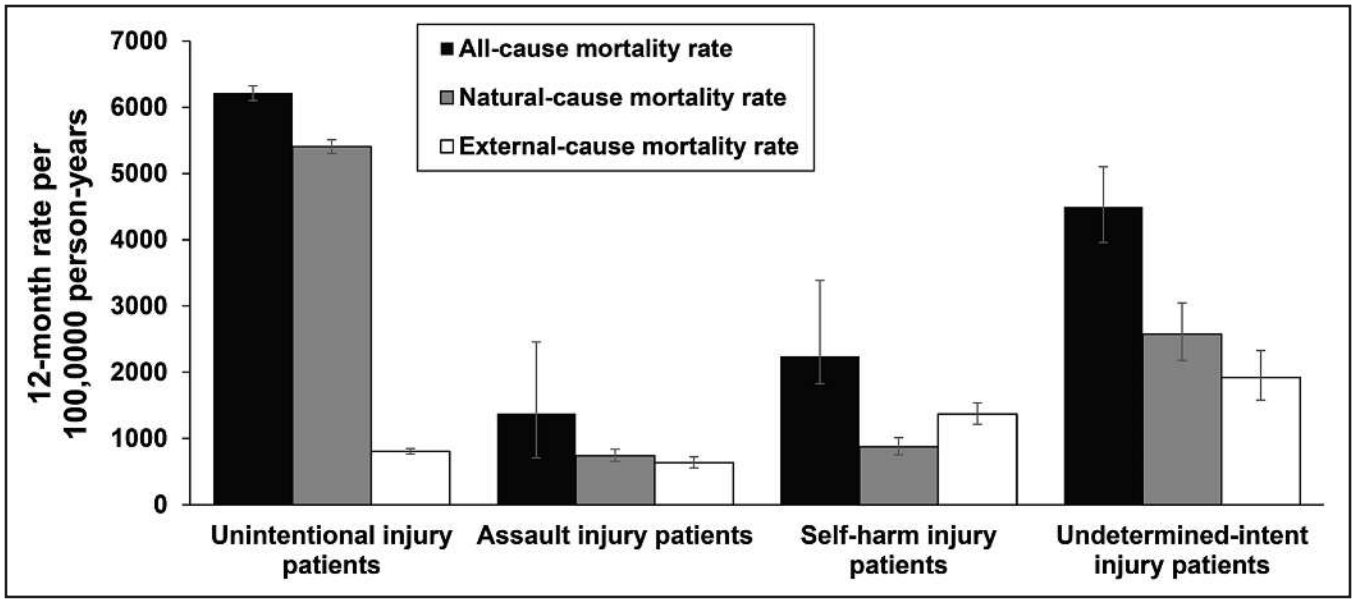

FIGURE 1. Rates of all-cause mortality, natural-cause mortality, and external-cause mortality among alcohol use disorder–involved injury patients, according to intent of index injury

high proportions of assault victims and suicide attempters were consuming alcohol at the time of their injuries, and that alcohol may function in these situations to lower inhibitions and increase risk-taking behavior (Giancola et al., 2011; Norström & Rossow, 2016; Roizen, 1997). For these assault- and self-harm–injured AUD patients, ED-based violence and suicide prevention interventions may be warranted (Fleischmann et al., 2008; Mercer Kollar et al., 2020; Miller et al., 2017; Stanley et al., 2018). Interventions targeting hospitalized patients may not reach all relevant patients; in our data, only 23% of assault-injured patients and 69% of self-harm patients were admitted as inpatients, consistent with national data (CDC, 2020).

We also found, however, that unintentionally injured patients had the highest all-cause 12-month mortality rate. Although we attempted to statistically account for group differences in age, gender, race/ethnicity, and insurance status, a high proportion of unintentionally injured patients with AUD were older than 45 years (57.2%, compared with 34.4% and 27.0% among self-harm and assault-injured patients, respectively), which likely contributed to their high mortality rate. Almost 90% of the deaths in this group were from natural causes, compared with much smaller proportions in the assault-injured (54%) and self-harm (39%) AUD groups. This patient group may disproportionately suffer from complex comorbid medical conditions that elevate their risk for compromised functioning across multiple organ systems. If so, it is possible that these conditions are related to chronic excessive consumption of alcohol over long periods, but we could not assess this directly in our data. For such patients, integrated care models that coordinate general medical care with addiction treatment may be valuable (Savic et al., 2017; Wakeman et al., 2019).

According to clinical guidelines in the United States (Center for Substance Abuse Treatment, 2009) and elsewhere (National Institute for Health and Care Excellence, 2011), patients for whom there is evidence of severe AUD or alcohol-related impairment should be referred for specialist treatment, medication management support, and other services (Simioni et al., 2015). However, many patients with AUD experience steep barriers when trying to access addiction specialists—including both structural barriers, such as long wait times to enter residential treatment facilities and provider stigmatization of AUD (Parkman et al., 2017a; Williams et al., 2018), as well as individual attitudinal barriers, such as thinking the problem would get better on its own (Oleski et al., 2010; Parkman et al., 2017a). Large proportions of ED patients who report willingness to receive postdischarge interventions do not make it to their first postdischarge appointments (Parkman et al., 2017b; Simioni et al., 2015). These challenges are even more pronounced for patients who are unhoused, lack transportation, have low incomes, or who have comorbid health conditions that limit their mobility. Low-barrier, accessible outpatient addiction services may facilitate these patients' entry into treatment and reductions in hazardous drinking (Wiercigroch et al., 2020).

Few direct comparisons between our results and those of other studies are possible, as most U.S.-based studies on mortality among AUD patients are decades old or involved highly selected patient samples (Roerecke and Rehm, 2013). The closest analog of which we are aware is a 2012 study by Callaghan and colleagues (2012) that used linked inpatient

TABLE 3. Associations between injury intent and 12-month all-cause mortality for male and female patients

	12-month all-cause mortality rate per 100,000 person-years			Adjusted Cox proportional hazards model for 12-month all-cause mortality	
Characteristic	No. of deaths	Rate	[95% CI]	HR_{adj}[b]	[95% CI]
Male patients					
Intent of injury					
Unintentional	7,094	6,372.7	[6226.1, 6522.7]	1.0	(ref.)
Self-harm	259	2,998.2	[2654.4, 3386.5]	0.91	[0.80, 1.03]
Assault	366	1,349.0	[1217.6, 1494.5]	0.53	[0.47, 0.58]
Undetermined	162	5,250.1	[4500.8, 6124.1]	1.43	[1.22, 1.67]
Female patients					
Intent of injury					
Unintentional	4,918	5,993.1	[5827.9, 6162.9]	1.0	(ref.)
Self-harm	195	1,677.9	[1458.1, 1930.7]	0.71	[0.61, 0.82]
Assault	104	1,474.7	[1216.8, 1787.2]	0.72	[0.59, 0.88]
Undetermined	77	3,450.3	[2759.7, 4313.8]	1.23	[0.98, 1.54]

Notes: No. = number; CI = confidence interval; HR_{adj} = adjusted hazard ratio; ref. = reference. [a]Adjusted for age, race/ethnicity, and payer at index visit.

and mortality data on hospitalized patients with AUD from California and reported an all-cause mortality rate of nearly 4,900 per 100,000—very similar to our estimated rate. Data from other countries also offer a comparison; in Denmark, a recent study found that the 12-month cumulative incidence of all-cause mortality among AUD patients at their first hospital contact was 5.2%—a rate again very similar to ours (Askgaard et al., 2020).

We found that crude mortality rates among male and female patients with alcohol involvement were fairly similar, although males had higher mortality after adjustment for age and other sociodemographic factors. Gender-specific mortality rates also varied somewhat by patient injury intent. Other studies have reported that among patients with AUD, SMRs appear to be higher among female patients compared with males (Roerecke & Rehm, 2014). Our study design and patient population differed from those in previous studies and notably included a large number of female patients, which could explain this inconsistency. Future research should examine gender-specific mortality patterns among AUD patients in ED and other clinical treatment settings.

Limitations

Our study had several important advantages, including a large population-based cohort of ED patients, from the largest and most diverse U.S. state; comprehensive coding of external cause of injury, which is not available in all states; and inclusion of mortality outcomes from validated high-quality registers, which are also not available in all states. However, several limitations should be considered when interpreting the results. During the study period, clinical diagnoses were made under ICD-9-CM, which used separate E-codes to document injury intent; our results may therefore not generalize to ED presentations using ICD-10-CM (National Center for Health Statistics and Centers for Medicare and Medicaid Services, 2015), which combines external cause–of-injury codes with diagnostic codes. Because the sociodemographic characteristics of California differ from those of other states, the results may not generalize to the entire United States. Mortality data for ED patients who died outside of California were not available for this study; we expect that this artifact resulted in a slight downward bias on the absolute mortality rates calculated for the ED patients. We could not assess alcohol involvement through breath tests, blood alcohol content, or other means other than diagnostic coding, and our estimate is therefore likely to be conservative. Furthermore, our administrative data set lacked other important information, such as patient injury severity, medication use, and socioenvironmental risk factors, which could have informed our risk estimates.

Conclusions

AUD-involved injury presentations to the ED are common and associated with high patient mortality burden. Mortality risk varies not just according to patient sociodemographic characteristics, but also by injury intent. Implementation of universal alcohol screening in ED settings, as well as improved linkage to outpatient care, could help to reduce excess mortality in these vulnerable patients.

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